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Use of pXRD in the quantitative assessment of alteration in epithermal Au deposits

Burkett, D.A.[1,2], Graham, I.[1], Ward, C.[1], Baensch, A.[2], and Chomiszak, G.[1]

[1]School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, NSW, Australia. d.burkett@unsw.edu.au
[2]International Mining Group, Olympus Scientific Solutions Americas

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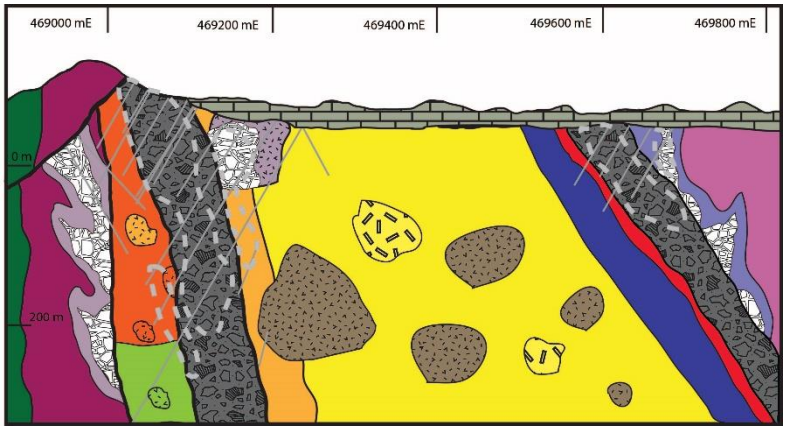
X-ray powder diffraction (XRD) is a well-established tool in the earth sciences, as it allows for the identification and quantification of mineral assemblages [1]. For epithermal Au systems, the quantification of alteration mineral assemblages can allow geologists to characterize the geometry of a deposit or geothermal system, and draw inferences regarding the fluid evolution and environmental conditions of deposition (e.g., pH, T). Traditionally, XRD devices have largely been restricted to laboratories; however, advances in XRD sample holders and X-ray sources have allowed for the development of portable XRD (pXRD) devices. This study assessed the applicability of the Olympus Terra pXRD instrument for qualitative and quantitative studies of hydrothermal systems. Comparisons were made to data from laboratory XRD (Empyrean II diffractometer) and from results using XRF techniques for both synthetic mixtures of natural minerals and a variety of samples from the Kulumadau epithermal gold deposit (Woodlark Island, Papua New Guinea [2]) and a number of deposits from the Drake Goldfield of northeastern NSW, Australia.

Diffractograms of synthetic mineral mixtures with known concentrations of quartz, kaolinite, muscovite, albite, and pyrite were firstly analyzed quantitatively using the Rietveld-based Siroquant technique and showed good overall agreement for both devices. Results from the pXRD unit for collection times of 5, 10, 20, and 40 minutes for representative samples spanning a range of rock types and alteration styles revealed that five minutes was sufficient for qualitative analysis, even of minor phases. Overall, the five-minute collection time also yielded excellent quantitative results, but precision for minor mineral phases increased noticeably with increasing collection times. Quantitative mineral estimates for 20- and 40-minute data sets were compared directly to estimates made using the Empyrean II data and showed excellent correlation with R2 values of >0.90 for all major mineral phases (i.e., >5%). Due to its portability, robustness, minimal sample preparation, relatively fast collection times, and excellent correlation with laboratory-based XRD devices, the pXRD has been shown to be of great use for rapid acquisition of quantitative mineralogical data by the exploration geologist, allowing for more informed and faster decisions during drilling programs.

References:

[1] Jenkins R and Snyder RL (1996) *Introduction to X-ray Diffractometry*. Wiley Publishers.

[2] Burkett et al. (2015) Can Mineral 53: 429-454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